"THE DIAGNOSIS AND RISK FACTORS FOR INTESTINAL HELMINTHS AMONG CHILDREN ATTENDING A NAIROBI DISPENSARY"

A dissertation presented in part fulfilment for the degree of Master of Public Health of the University of Nairobi.

by

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DECLARATION

I declare that this thesis is my own original work and has not been published elsewhere or presented for a degree in any other university.

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LIST OF ABBREVIATIONS

CO	-	Clinical Officer
MO	-	Medical Officer
PEM	-	Protein Energy Malnutrition
MCH	-	Maternal and Child Health
SD	-	Standard Deviation
+PV	-	Positive Predictive value
-PV	-	Negative Predictive value
CI	-	Confidence Interval
OR	-	Odds Ratio
Mls	-	Millilitres
Ksh	-	Kenya Shillings
URTI	-	Upper Respiratory Tract Infection
GIT	-	Gastro intestinal tract

SUMMARY

In most health facilities in Kenya, the diagnosis of intestinal helminths has been and continues to be based on clinical criteria. This is the situation even in places where laboratory facilities are available.

It was therefore the main aim of this study to determine the reliability of this method. The study was carried out between March 1989 and June 1989 among children attending a Nairobi City dispensary.

A case-control study was conducted among the children aged 10 years and under. A case was any child 10 years and under who after medical consultation had an anthelminthic drug prescribed. A control was any child 10 years and under who after medical consulation had no anthelminthic drug prescribed. 201 cases and 201 controls were included in the study. Of these,163 stool specimens were received from the cases and 162 were received from the controls.

It was found that 47 (28.83%) of the cases had one or more intestinal helminths on stool examination. 16 (9.88 %) of the controls were also found to be infected with one or more worms. This over-diagnosis leads to the use of drugs and thus over-expenditure on anti-helminthic drugs.

From this study it was found that the following socio-economic factors were associated with the presence of intestinal helminths:

1. Father's education status
2. Mother's education status
3. Child's age
4. Father's age

Clinically, the important signs and symptoms that revealed an association with intestinal helminth infection were :

1. Abdominal pain
2. Rumbling in abdomen
3. Pallor
4. Weight for age less than -2 standard deviations
5. Height for age less than -2 standard deviations.

The present method of management and control of intestinal helminths has been shown to be expensive and wasteful. Setting up a laboratory with a trained microscopist is much cheaper and in the long run a more effective control strategy.

Chapter 1 : INTRODUCTION

PROBLEM STATEMENT

The diagnosis of intestinal worms in most hospitals, health centres and dispensaries, in Kenya is based on clinical findings. A definite diagnosis is established on finding eggs, larvae or actual worms in the stool of the individual. This requires laboratory facilities and trained personnel. In Kenya, like most developing countries, this is only possible in very few of the available health facilities.

Although clinical diagnosis of intestinal helminths has been going on for a long time in Kenya without laboratory support, its efficiency and efficacy per se have not been documented. Intestinal helminths are widespread in Kenya, the drugs used are expensive, and the laboratory facilities are insufficient or under-utilized, hence the necessity for testing the adequacy of the clinical diagnostic method.

Children, the majority of whom are at a critical time of growth and development suffer most from these infections. They are the most energetic, most inquisitive about the environment and many still careless and ignorant about cleanliness and personal hygiene. They roam around the house and neighbourhood much more than the adults thus constituting the highest risk group with regard to exposure to infection and re-infection.

Chapter 2

LITERATURE REVIEW

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2.1 General

Intestinal helminths are distributed throughout the world and especially in the tropics and subtropics (1,2,4). They are so named because part of their life cycle includes a period of obligatory residence in the human alimentary tract.

The infection by intestinal helminths is persistent in nature and reinfection as well as auto-infection do occur frequently especially in endemic areas. In general morbidity is proportional to the intensity of infection (2). Making the situation even more complicated is the fact that many individuals are likely to be infected by more than one species concurrently, thus making assessment of total morbidity associated with these parasites difficult and complex (3).

Although mortality from these infections is low, complications do occur including malabsorption, diarrhoea, blood loss, impaired work capacity and reduced growth rate thus constituting an important health and social problem (2,3). In many countries therefore, endemic intestinal helminthiasis is closely related to economic and social development (3). The prevention and control of these diseases is now more feasible because of the availability of safe and efficacious drugs (4,5,6)

The amount of harm caused by intestinal helminths to the health and welfare of individuals depends on numerous factors including:

- the parasitic species.
- the intensity and duration of the infection.
- the nature of the interaction between the parasite and concurrent infections.
- the nutritional status and immunological status of the host individual.
- numerous socio-economic factors.

It is therefore quite difficult to measure the effects caused by intestinal helminths especially taking into account the fact that many infections are asymptomatic and thus remain undetected. Some persons may present with vague generalized complaints (3).

Estimates of global prevalence of intestinal nematode infections transmitted through the soil are as follows: (4)
1,000 million cases of Ascaris lumbricoides
900 million cases of hookworm (Ancylostoma duodenale and Necator americanus)
500 million cases of Trichuris trichiura.

As already mentioned, intestinal helminths are relatively common in developing countries. It is estimated that on average 40 - 99% of the population are infected with the three most common ones, that is, Ascaris, hookworm and Trichiuris. The most infected and affected are the children (4). This is mainly due to differences in behaviour and occupation between adults and children. The home is a major focus of infection and education of the mother is reflected in the weight of the infection in children. Because of over-crowding in some parts of the towns, the prevalence may be higher than in some rural areas. (7)

Recently it has been found that recurrent and persistent infections play a major role in growth faltering in children leading to malnutrition (3,8,9). Under most circumstances, malnutrition and infection interact synergistically, that is, one condition accentuates the other. Malnutrition tends to increase host susceptibility to infection and infection may precipitate or aggravate malnutrition. The malnourished child tends to harbour infectious agents for longer periods and often has more severe clinical manifestations than in the well nourished child (23).

2.2 Ascaris

Ascaris lumbricoides occurs throughout the world. It is transmitted through the ingestion of the infective eggs from contaminated food, hands or water (8).

An adult female worm living inside an infected person produces on average about 240,000 eggs per day for about a year, these are passed out in the feaces. The eggs develop in the soil within 2-3 weeks given optimal temperatures, presence of oxygen and moisture.

On being swallowed, each egg develops into a larval worm in the small intestine. The larvae migrate through the body via the hepatic portal system to the liver and lungs where they develop further for 1-2 weeks. Then they return to the small intestine and attain sexual maturity. The release of eggs by the female worms begins about 2 months after ingestion of infective eggs. Adult worms are large with the male worms measuring up to 20cm and the females up to 45cm in length. A. lumbricoides is highly specific for man and the infection does not produce a strong protective immunity. For its survival, the parasite depends greatly on a high reservoir of infective eggs in the environment and thrives in areas where there is lack of sanitation.

Several types of complications are associated with ascariasis (17, 18, 21, 22). Abdominal complications, especially, do occur and require hospitalization. These include intestinal obstruction produced by a bolus of worms, migration of adult worms to bile and pancreatic ducts, respiratory passages and peritoneum. These conditions do cause medical and surgical emergencies. Ascaris pneumonitis due to larval migration is probably quite common although it is rarely detected clinically. A. lumbricoides releases powerful allergens which may induce hypersensitivity (8).

"Chronic" ascariasis is the most common form of Ascaris infection since individuals tend to be re-infected repeatedly for much of their lives. Pre-school children are the groups at greatest risk to actual or potential harmful effects. Nutritional status of children may be adversely affected during ascariasis, particularly if their food intake is marginal in quantity or quality (3).

In September 1984, a conference on Ascaris and its Public Health significance was held in Banff, Canada.

The delegates reviewed the present knowledge concerning relationship between Ascaris lumbricoides infection and childhood malnutrition. It was thus concluded that ascariasis contributed to poor nutritional status in children (25).

2.3 Hookworm infection

This is caused by either Ancylostoma duodenale or Necator americanus. They are blood sucking nematodes and the adult stages are found attached to the mucosa of the small intestines especially the jejunum in many people living in the tropics and sub-tropics (26).

These may occur singly or as mixed infections with other intestinal helminths.

The life cycle of hookworm begins with the eggs being released by the female worms into the lumen of the small intestine. These are then passed in the faeces. With the right environmental conditions, that is, moisture, warmth and oxygen, the eggs develop and hatch rapidly.

The infective larvae develop 5-10 days after eggs are passed. Infection occurs when these larvae enter the body through the skin most, normally through the feet. Larvae of A. duodenale also cause infection by mouth.

Poor sanitation, indiscriminate defaecation and going bare foot ensure constant exposure to infection (3). Adult A. duodenale and N. americanus survive for 1 and 4 years respectively.

Hookworm infection causes chronic blood loss leading to a depletion of the body's iron stores and eventually iron deficiency anaemia. This is particularly relevant for young children and pregnant mothers, it also affects the health and productivity of adults (3,26). Anaemia is associated with a diminished capacity for sustained hard work and exercise. Loss of blood plasma can also lead to hypoalbuminaemia in some individuals. This may precipitate protein energy malnutrition in children.

But the contribution of hookworm infection to malnutrition is in general not as well established as its role in iron deficiency anaemia.

2.4 Trichuriasis

The distribution is worldwide with a relatively high prevalence; relatively little research has been done on this infection until recently (26). The adult worms of this nematode are known to survive for as long as 5 years. They are attached firmly and deeply to the epithelial lining of the large intestines especially the caecum. Each female produces between 2,000-14,000 eggs per day. These are passed in stool into the environment. The infective larvae develop inside the eggs in about three weeks. About 70-90 days after infective eggs are swallowed, the host begins to pass T. trichiura eggs indicating the presence of adult worms in the large intestine.

The morbidity associated with trichiuriasis is due to the worm's mode of attachment to the wall of the large intestine (3). Each worm is about 50mm long and has a thin anterior part with which it burrows into the intestinal wall where it feeds on the intestinal tissues. The degree of morbidity is related to the intensity of infection. Chronic impairment of the hosts nutritional status should be suspected when diarrhoea, hypoalbuminaemia and iron deficiency are observed in association with this parasite. It may cause anaemia but less frequently than do hookworms. When anaemia occurs, it is due to alteration of the small intestine resulting from a very heavy worm burden.

2.5 Strongyloidiasis

Strongyloides stercoralis is widely distributed in the tropics especially in areas of poor sanitation (3,24). The infection occurs when 3rd stage larvae which have developed in soil contaminated by human feacal matter penetrate the skin.

The larvae migrate first through the tissues and then via the lungs to gain access to the small intestines, where the adult females develop and live in the epithelium of the jejunal mucosa. The females penetrate deep into the mucosal glands and begin to release eggs from which larvae emerge while still in the intestine. Larvae reach the external environment in the stool and some develop into infective, skin penetrating, 3rd stage larvae, while some grow into free living adult male and female worms.

Sometimes the larvae become infective before they are passed out. This leads to autoinfection. Therefore some people may remain infected with S.stercoralis for years even after leaving endemic areas.(24)

Infected individuals may complain of diarrhoea and weight loss. Malabsorption may occur due to lesions in the mucosa of the small intestine. Many infected people remain asymptomatic but if their immunity is compromised, they may develop disseminated strongyloidiasis, with the occurrence of larvae in many organs, and this can be fatal. Much more work needs to be done on the public health significance of this infection.(3)

2.6 Enterobiasis

Enterobius vermicularis worms live in the large intestine (24). They are common in children and are found more in the temperate regions and developed countries than in the tropics. This infection causes anal pruritus leading to insomnia. It may interfere with school performance and learning ability in children.

2.7 Taeniasis

The adult Taenia saginata and Taenia solium live in the small intestine of man. These infections are acquired through the ingestion of infective cysticerci in uncooked or improperly cooked beef (Taenia saginata) or pork (Taenia solium). The adult forms of both worms are large and produce a variety of gastrointestinal symptoms.

The most serious form of T. solium infection is a condition called cysticercosis in which cysticerci develop in the human body. This condition can be fatal. T. saginata infection rarely causes clinical problems (3).

2.8 Hymenolepiasis

Hymenolepis nana adult worm is about 40mm long and lives attached to the mucosa of the small intestines (3,24). The life cycle is direct and may involve an internal autoinfection process. Person to person transmission may also occur. During auto- infection, the eggs discharged by the adult tapeworm hatch in the intestine to release larvae which penetrate the villi and develop there to form cysticercoid stages. These are liberated from the villi and after activation, develop into adult tapeworms.

Intense H. nana infection may be found in under-nourished or immuno-compromised children. The cysticercoid stages damage the intestinal mucosa leading to protein loss. Diarrhoea, abdominal pain, weakness and weight loss have been associated with hymenolepiasis.

2.9 Kenyan situation

As indicated in the table below, intestinal helminths are widespread in Kenya (10). The prevalence rates today are comparable with those of 60 or more years ago (11).

Table 1

Prevalence rates (%) of hookworm, Ascaris and Taenia in 5 regions of Kenya from 1900 to 1983.

	Hookworm	Ascaris	Taenia
Coast	55.6	22.5	19.5
Highlands around Mt. Kenya	21.6	34.2	16.1
Nairobi	14.2	27.7	12.6
Rift Valley	13.3	21.2	15.7
Western	23.5	34.2	9.0

Although the majority of the Kenyan population have at one stage or another had one or more intestinal helminths, the relative importance of this in terms of mortality and morbidity is not clear (11). As already mentioned, many persons with helminthic infection are asymptomatic and therefore remain undetected.

From an economic study done on the cost, prevalence and approaches for control of Ascaris infection in Kenya, it was found that the present strategy using anthelminthics as the main control measure is very expensive both to the country and the patients (14). To make matters worse, there appears to be little impact by this intervention method.

Eradication of intestinal helminths is difficult as it is closely linked to the socio-economic development. Meanwhile efforts at improving diagnosis and treatment should be intensified. The most important intestinal helminths in Kenya are: Ascaris, hookworm, Taenia, Trichuris and Enterobius (11). The prevalence of the different species of intestinal helminths varies according to their ecological requirements.

Some are significantly more prevalent in warm, moist regions of low altitude such as coastal lowlands in the case of hookworms (12,13). Ascaris appears to be less affected by changes in climate and overall prevalence rates do not differ significantly in the various regions of the country (14). But there is a slight trend for higher rates of Ascaris in the Western and Highland regions and Taenia in the Rift Valley and Highland regions.

It has been estimated that about 25% of Kenyans are infected with Ascaris and hookworm. Ascaris, hookworm and Taenia have all been implicated as being capable of affecting the nutritional status of the infected individuals (15,16). In Kenya it has been estimated that one out of every 4 children is stunted (9). The contribution of intestinal worms to this stunting has not been determined but infections generally play a major role.

Hookworm is the most common cause of iron deficiency anaemia especially along the coastal regions. Ascaris contributes to malnourishment and reduced growth rates in children as well as being a major cause of intestinal complications (17,18). Taenia has also been linked to some clinical manifestations and the complications may be more serious in children.

Efforts to establish control programmes have been limited in this country. Only one project on Ascaris control has been attempted; in Machakos(19).

Evaluative studies of other parasitoses diagnosed clinically in Kenya have not been documented. A study on malaria diagnosis in Rural Health units was carried out between 1979 and 1980 (20). From the results obtained, it was found that only 44.73% of patients diagnosed as having clinical malaria in an endemic area were positive for malaria parasites on blood slide microscopy.

This revealed a lot of over-diagnosis resulting in over-spending on the part of the Government. The second aspect is that of failing to diagnose correctly a serious or fatal disease.

It is evident that more work needs to done on the various aspects of diagnosis control and treatment of intestinal helminths. It was therefore the aim of this study to consider the reliability of clinical diagnosis of intestinal helminths in a dispensary in Nairobi.

Intestinal helminths are preventable. They have almost disappeared in developed countries where there is a high standard of sanitation. It is therefore probable that they may eventually disappear from developing countries with improvement in personal hygiene, increased latrine use and greater availability of safe water (24).

Chapter 3

MATERIALS AND METHODS

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3.1 OBJECTIVES

3.1.1 General

The broad objective of the study was to determine the validity of clinical diagnosis of intestinal helminths among children aged 10 years and under seen in a dispensary in Nairobi and to determine and identify those clinical manifestations and other characteristics that are most commonly associated with a true (laboratory confirmed) diagnosis.

3.1.2 Specific

1. To describe the socio-demographic profile of a population of children aged 10 years and below attending a large urban dispensary in Nairobi.

2. To determine the validity of clinical diagnosis with respect to laboratory diagnosis based upon stool examination.

3. To determine among the children, associations between a laboratory confirmed diagnosis of intestinal helminths and:

   3.1 Presenting clinical manifestations

   3.2 Socio-demographic variables including age, family size, parental education and occupation,and area of residence.

   3.3 Anthropometricindices ofnutritional status including weight for age, weight for height, height for age.

4.1 To determine the cost of using the current method of diagnosis and treatment.

4.2 To determine the cost of setting up laboratory facilities.

3.2 Justification

Intestinal helminths are widespread in Kenya and cause considerable morbidity. Although mortality is low, some of the worms interfere with nutrition, growth and development of children as well as work and productivity of adults. Furthermore expenditure on medical care of "infected people" may use considerable portion of the funds available in the national health budget. Substantial social and economic benefits can therefore be derived from the control of these diseases by more accurate diagnosis and therefore treatment.

Most of the urban growth is due to migration from rural areas. Migrants come in search of jobs and a better life. Often they find that health, housing and sanitary conditions in the city are worse than what they left behind. This in many cases leads to overcrowding, thus permitting the spread of intestinal helminths. As in many large cities in other places, it is necessary to find effective means to deliver basic health and other services.

The problem of intestinal helminths has been recognised and it affects many people. It is likely to get worse as the population continues to grow. Information is therefore required by the planners and policy makers in relation to the efficient and effective diagnostic procedures and control of intestinal helminths especially at the most peripheral level where laboratory facilities will continue to be unavailable for a long time to come. Presently there is a problem in the Third World countries of making national decisions in health care with inadequate information or incorrect returns under the constraint of competing claims for allocation of scarce resources in terms not only of funds but also of diagnostic materials, drugs, delivery services and personnel.

It is very likely that many infected children go home untreated. They continue to be a potential source of infection to those who have been treated and to the uninfected. They themselves also suffer the effects of having these infections.

3.3 Hypotheses

1. Clinical diagnosis versus laboratory diagnosis of intestinal helminths do not correspond.

2. Protein energy malnutrition is more frequent in children infected with intestinal helminths than in the uninfected.

3. There is inverse correlation between intestinal helminth infection in children, and maternal education and other factors.

4. The current use of anthelminthic drugs is inefficient and not cost effective.

3.4 METHODOLOGY

3.4.1 Study design

This study was undertaken at Jericho Dispensary in Nairobi between March 1989 and June 1989. It was a case control study with the population comprising of children attending the dispensary for curative services.

Jericho Dispensary is situated in Jericho Estate in the Eastlands of Nairobi. It serves people mainly from three estates namely Jericho, Uhuru and Buruburu. As well as offering curative services, there is also a School Health Section and a Maternal and Child Health and Family Planning (MCH and FP) Section. Jericho is the largest City Commission dispensary operating 24 hours every day and 7 days each week. There are 2 cadres of clinicians in this health facility, a medical officer and a clinical officer. On average about 200 patients are seen each day (excluding the night).

Laboratory facilities are available here but these are utilized mainly by the MCH and FP sections from this dispensary and those sent from other clinics nearby. This is one of only two laboratories available within the City Commission.

3.4.2 Study Population

The population of Nairobi according to the 1979 Census was 827,775. It is estimated to be 1,429,041 by 1989 assuming constant levels of fertility and mortality.

Nairobi being the capital city of Kenya has the majority of employment opportunities both in the public and private sector. Many people therefore come seeking employment. A large proportion of migrants into the city have little education and as such, cannot get well paid jobs. The low income leads to poor housing, an inadequate diet and overcrowding.

There is in many cases inadequate clean water, and unhygienic environmental conditions; these may promote the spread of helminthic infection. The whole population is at risk of getting infected with worms, but children are at a higher risk because of their tendency to crawl around and play in the soil and often their ignorance.

3.4.3 Definition of Population

The study group were children 10 years of age and under. In Nairobi, this is approximately 30% of the total population. The ones selected were from among those attending the dispensary for treatment.

3.4.4 Study Area

Jericho estate in which the Jericho dispensary is situated in the Eastlands area of Nairobi. It was built during the colonial days. This was the first estate built for the 'natives' that had self-contained houses.

The houses either have one or two bedrooms. Each unit was initially occupied by one family but now up to three families can be found in one such unit.

The other estates served by Jericho Dispensary are much newer and were built after independence.

The Nairobi City Commission has provided health facilities in various areas of the city. These facilities provide free medical services which include curative, preventive and promotive aspects of health care.

3.4.5 Sample size

Formula :

$$n = \frac{z^2pq}{d^2}$$

Minimal sample size is 200 cases, where :

n = the desired sample size

z = the standard normal deviate usually set at 1.96 which corresponds to the 95% confidence level.

p = the proportion of the target population esti mated to have the characteristic in this study of intestinal helminths taken to be 0.2

q = 1.0 - p

d = degree of accuracy desired usually set at 0.05

3.4.6 DATA COLLECTION

Selection of subjects

This was carried out after the patients had been seen by the clinician and were now awaiting their drugs.

Definition of Case

Any child 10 years and under who after medical consultation had an anthelminthic drug prescribed.

Definition of Control

Any child 10 years and under who after medical consultation had no anthelminthic drug prescribed.

Excluded from the study

1. Very sick children e.g with dehydration or bronchopneumonia.
2. Children with known chronic conditions e.g heart disease, sickle cell anaemia.

Questionnaire Administration

A pre-tested questionnaire was administered to the mothers (or companions) of all the children selected using the above criteria. It was carried out either by the principal investigator or a trained assistant.

Examination

The general examination of each patient was carried out by the principal investigator, while the other measurements taken, that is weight and height/length and weight were taken with the help of the trained assistant.

Pallor was assessed in each child by the principal investigator. This was done by examining both the mucous membranes of the mouth, and the conjuctivae.

Height/Length

The standing height of each child was measured to the nearest 0.1 cm using a locally made height meter with a mobile headpiece. Children under 2 years of age had their length measured using a length board with a stationary headpiece.

Weight

The weight was measured using a portable, battery powered, digital read-out 'Health Scale to the nearest 0.1 kg without shoes but with light shorts and shirt for boys and a light dress for girls. All other clothes were removed. The scale was zeroed before every reading.

For young subjects unable or unwilling to stand still on the 'Health Scale', the subject's mother or other caretaker was weighed both alone and while holding the child. The difference was calculated and recorded as the subject's weight.

Quality control measures

1. The research assistant had preliminary and ongoing training.
2. Duplicate reading of measurements by the principal investigator and assistant.
3. Checking recorded measurements.
4. Equipment checked regularly.

Parasitological Examination

At the end of the examination, each mother/companion was given a labelled universal bottle. Each bottle had 14 mls of 4 % formal saline solution. A wooden tongue depressor was also given to assist in putting the stool in the bottle. Emphasis was placed on having the bottles with the specimens returned as soon as possible.

The parasitological examination of the stool specimens was carried out in the Department of Community Health with ssistance from the Department of Microbiology.

For all the stools (single specimens) received, they were examined for the presence of intestinal helminth eggs (or larvae) using the Formol saline-ether concentration technique. For each parasite found, the infection load was measured semi-quantitatively. This was done by counting the number of eggs using low power (x 10 objective), lying beneath the whole 22 by 22 mm cover slip. It was estimated that this count represented the count for 0.5g of stool.

Sources of Bias

There may be no eggs in the stool but the the child is infected in the following situations:

1. Male worms only present.
2. Immature worms present.
3. Non-fecund female worms only present.

The following factors may affect the egg count:-

1. Quantity of stool passed.
2. Distribution of eggs within the stool.
3. Daily egg output by female worms.
4. Worm load, at high worm loads output of eggs per female is reduced.
5. Accuracy of technique for stool examination.
6. Age of worms.

Assumptions

The following assumptions were made at the beginning of this study;

1. Funds would be made available as and when required.
2. Reasonable amount of cooperation would be forthcoming from the health centre staff and the patients.
3. Availability of staff/ supervisors to give necessary guidance.

Limitations

1. Availability of funds
2. Cooperation from patients - some specimens not brought back.
3. Specified time

Ethical Considerations

This project was carried out within the health facility under the umbrella of the City Commission. All mothers whose children were included in this study were required to give informed verbal consent to being part of the study. The children found to have intestinal helminths among the control group were given anthelminthics. Other medical conditions found for which no medication had been given were managed appropriately. No invasive procedures were performed on any of the subjects included in the study.

Chapter 4

RESULTS

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4.1 SocioDemographic Profile

4.1.1 Sex Distribution

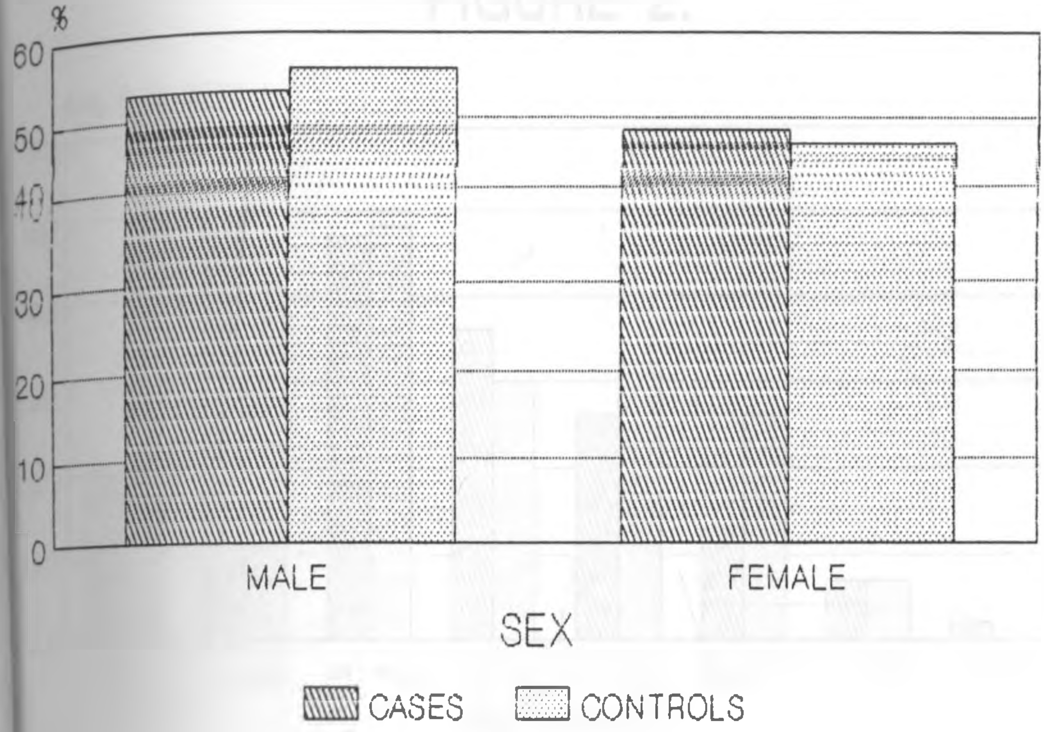
There were altogether 201 cases and 201 controls selected for this study. The cases had 107 (53.2%) males and 94 (46.8%) females while in the control group there were 112 (55.7%) males and 89 (44.3%) females as shown in Figure 1 below:

4.1.2 Age Distribution

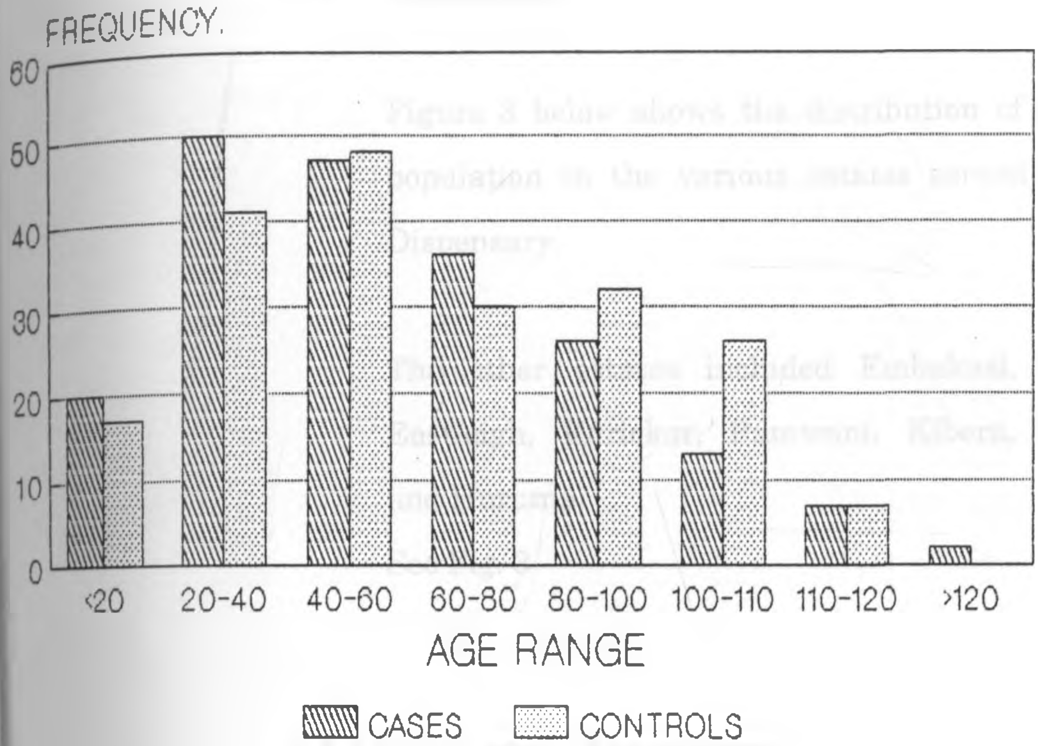
The mean age for the cases was 57.06 months with a minimum of 5 months and maximum of 162 months. The median fell at 50 months. The controls on the other hand had an average age of 62.04 months, the minimum being 9 months and maximum being 128 months. The median for the controls was at 57 months. The age difference between the two groups especially in relation to the median is not statistically significant (T value = 1.55748, P = 0.1194). See Figure 2.

SEX DISTRIBUTION

FIGURE 1.



AGE DISTRIBUTION
FIGURE 2.



4.1.3 Residence

Figure 3 below shows the distribution of the sample population in the various estates served by Jericho Dispensary.

The other estates included Embakasi, Westlands, Eastleigh, Kariokor, Pumwani, Kibera, Kariobangi and Huruma.

See Fig. 3

4.1.4 Other area of residence

12.9% of the cases and 13.9% of the controls had lived only in Nairobi since birth. The rest as well as residing in Nairobi had also lived elsewhere. The 8 'others' includes areas lived in outside Kenya, like Uganda, Tanzania and Zaire.

See Table 2 below.

DISTRIBUTION OF SAMPLE POPULATION IN VARIOUS ESTATES. (FIG3)

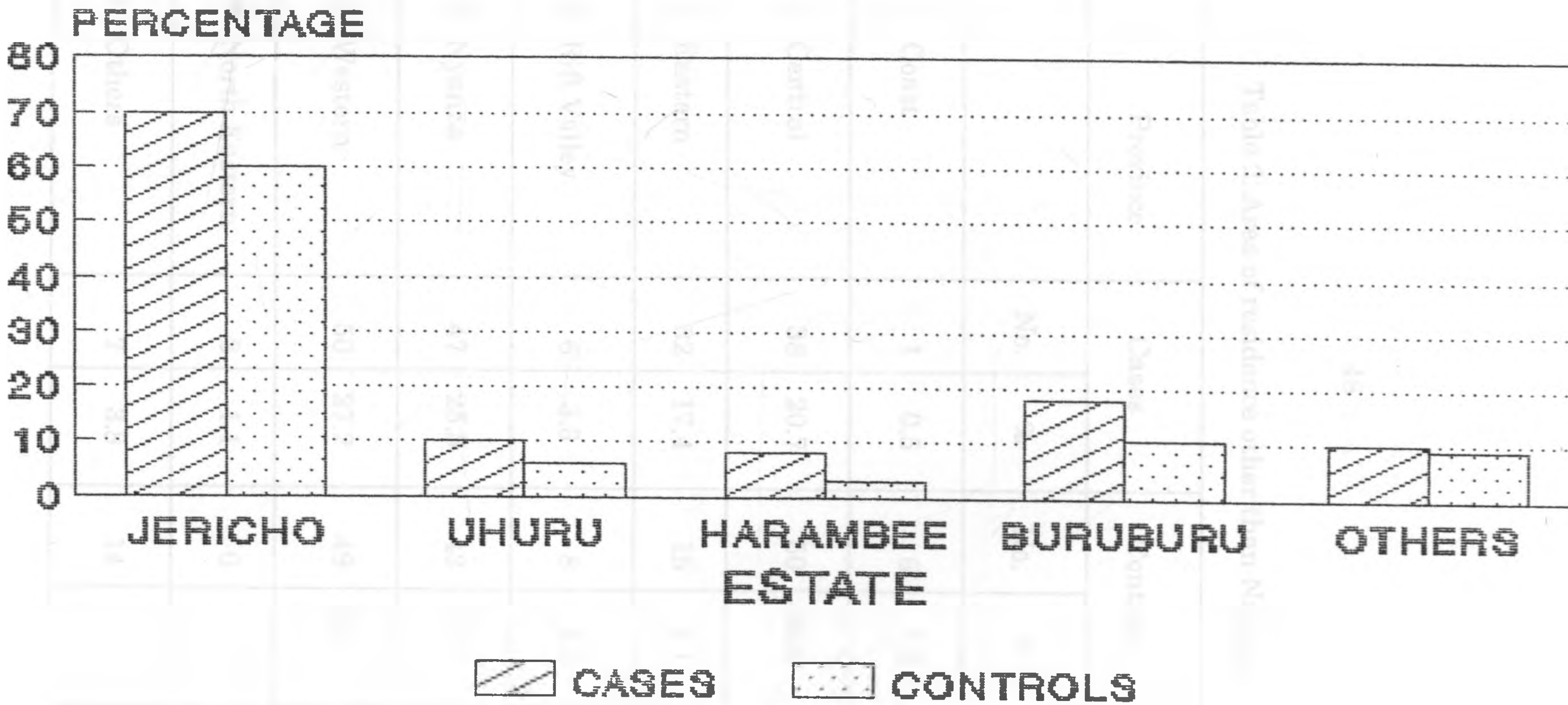
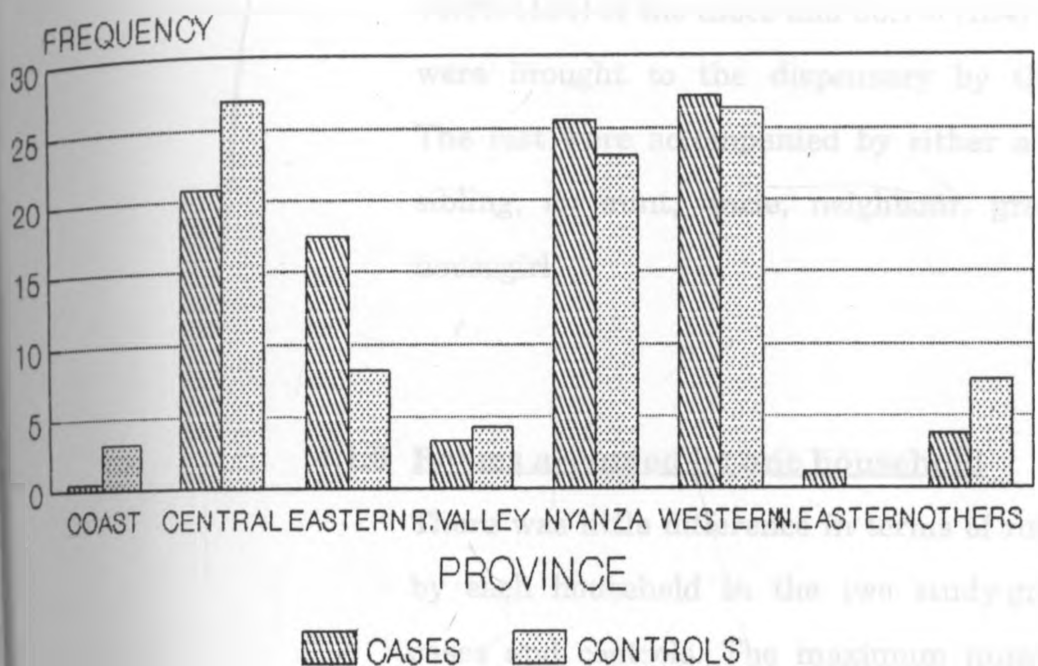


Table 2: Area of residence other than Nairobi

Province	Cases		Controls	
	No.	%	No.	%
1. Coast	1	0.5	6	3.2
2. Central	38	20.7	50	26.9
3. Eastern	32	17.4	15	8.1
4. Rift Valley	6	3.3	8	4.3
5. Nyanza	47	25.5	43	23.1
6. Western	50	27.2	49	26.3
7. North Eastern	2	1.1	0	0
8. Others	7	3.8	14	7.5

AREA OF RESIDENCE
OTHER THAN NAIROBI
FIGURE 4.



4.1.5 Child's companion at the clinic

76.6% (154) of the cases and 66.7% (134) of the control were brought to the dispensary by their mothers. The rest were accompanied by either a father, older sibling, an aunt, uncle, neighbour, grandmother or housegirl.

4.1.6 Rooms accupied by one household

There was little difference in terms of rooms occupied by each household in the two study groups, that is, cases and controls. The maximum number of rooms is 4 with the minimum at 1 and median falling at 2. The mean number for cases was 2.01 and controls 2.22.

4.1.7 Adults in household

The number of adults in the households occupied by the cases and controls were as follows:

	Cases	Controls
Minimum	1	1
Median	3	3
Maximum	8	7
Mean	2.90	2.97

Table 3: Number of adults living in household

4.1.8 Children in household

There was also marked similarity in the number of children per household among the cases and the controls.

	Cases	Controls
Minimum	1	1
Median	3	3
Maximum	10	10
Mean	3.54	3.71

Table 4: Number of children per household

4.1.9 Water and Sanitation

100% of all the cases had access to piped water. Either a tap in the house or a standpipe which was used by several households. 99% of all the controls also had access to piped water. 33.3% of all the cases lived in households that had a latrine/toilet which was shared by one or more households, 28.9% of the controls also shared latrines. The other households had one toilet to each household. The majority of the population, as already seen, came from Jericho, Uhuru, Harambee and Buru Buru Estates all of which have flush toilets in their houses.

4.1.10 Parent's Marital Status

20 cases (10%) had single unmarried mothers and 22 controls (10.9%) also had an unmarried single mother. 12 cases (6.0%) and 9 controls. (4.5%) of the controls had divorced/separated parents. The rest had both parents living together.

4.1.11 Age of Fathers

	Cases	Controls
Minimum	24	26
Median	35	35
Maximum	70	55
Mean	35.89	35.74

Table 5: Age distribution of fathers

4.1.12 Age of Mothers

As can be seen from the table below, these were very similar.

	Cases	Controls
Minimum	18	19
Median	27	27
Maximum	45	46
Mean	28.14	28.41

Table 6: Age distribution of mothers

4.1.13 Number of wives

In total, 41 mothers (12.1%) had co-wives. Among the cases, 25 (15%) had co-wives, among the controls. The maximum number of wives among the cases was 3 and among the controls this was 2.

4.1.14 Parent's Education Level

The father's education level was obtained from 148 (51.4%) of the cases on 140 (48.6%) of the controls. These were distributed as shown the Figure 5 and 7 below. The education level of the fathers for the remainder of the children could not be obtained because the companion of the child at the time of the interview did not know this. An attempt was made to make them go home and find out but there was minimal success.

	Education Level	Cases	Controls
1.	Nil	7(4.7%)	4(2.9%)
2.	Primary	34(23.0%)	22(15.7%)
3.	Secondary	(100(67.6%)	99(70.7%)
4.	Professional	7(4.7%)	8(5.7%)
5.	University	0	7(5.0%)

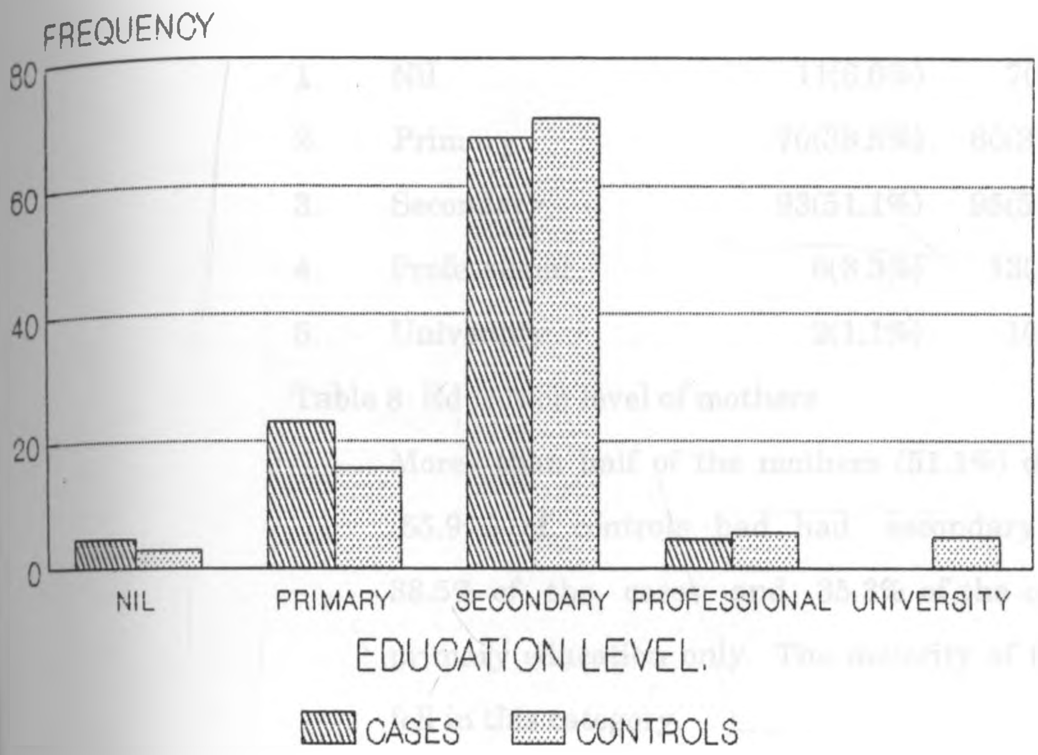
Table 7: Education level of fathers

Majority of the fathers of both cases and controls had had a secondary education.

The mothers' education level was obtained from 51.7% of the cases and 48.3% of the controls. These were distributed as shown in the Figure 6 and Table 8 below:

FATHERS' EDUCATION LEVEL

FIGURE 5.



	Education Level	Cases	Controls
1.	Nil	11(6.0%)	7(4.1%)
2.	Primary	70(38.5%)	60(35.3%)
3.	Secondary	93(51.1%)	95(55.9%)
4.	Professional	6(3.3%)	13(3.7%)
5.	University	2(1.1%)	1(0.6%)

Table 8: Education level of mothers

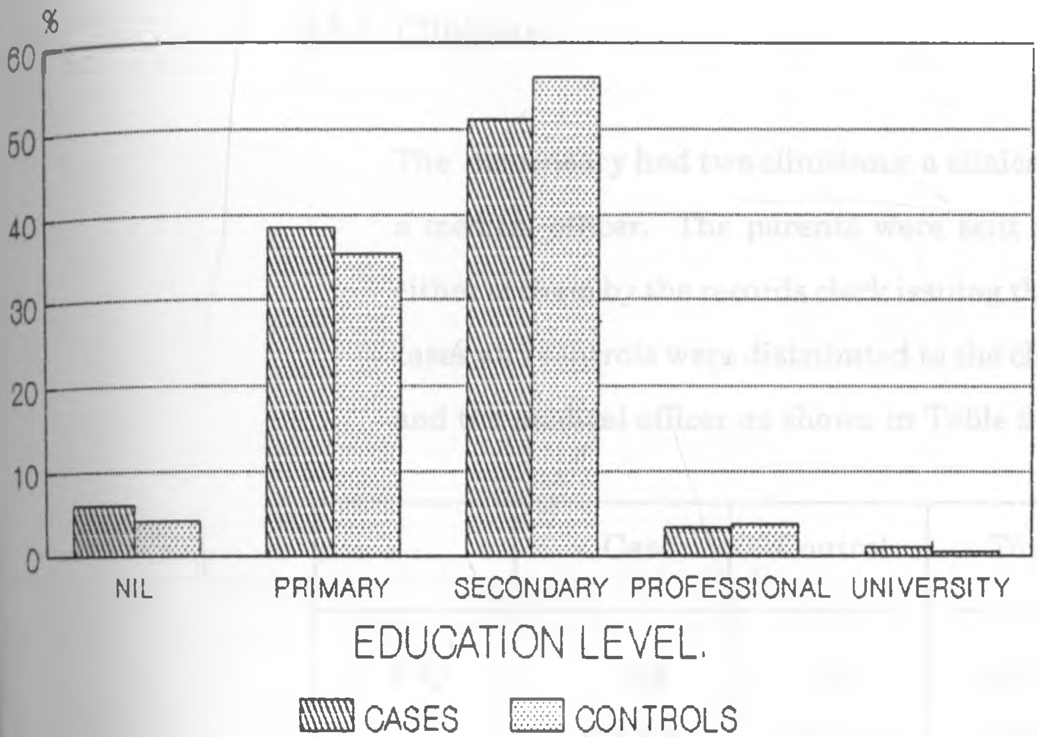
More than half of the mothers (51.1%) of cases and (55.9%) of controls had had secondary education. 38.5% of the cases and 35.3% of the controls had primary education only. The majority of the mothers fell in this category.

4.1.15 Parent's Employment Status

Most of the fathers were employed. 95.3% of the cases and 95.4% among the controls. Less than half of the mothers were employed. Only 33.3% among the cases and 44.6% among the controls. Employment in this situation includes those in formal employment as well as those who are self-employed.

MOTHERS' EDUCATION LEVEL

FIGURE 6.



4.2 Morbidity

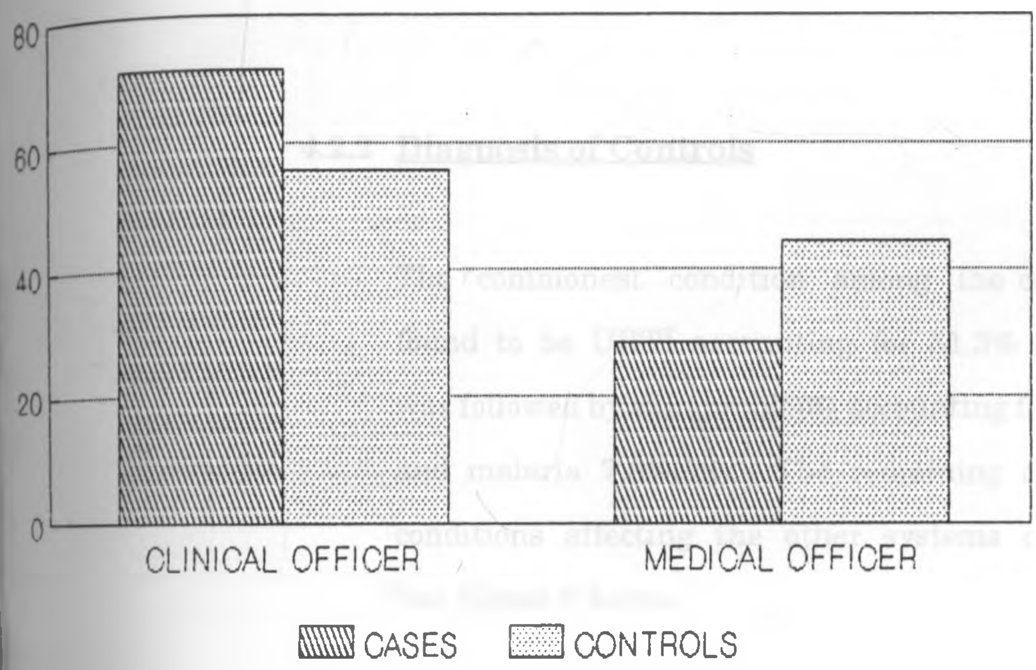
4.2.1 Clinician

The dispensary had two clinicians: a clinical officer and a medical officer. The parents were sent randomly to either of them by the records clerk issuing the cards. The cases and controls were distributed to the clinical officer and the medical officer as shown in Table 9 below:

	Case	Control	Total
C.O	144 (71.6%)	112 (55.7%)	256 (63.7%)
M.O	57 (28.4%)	89 (44.3%)	146 (36.3%)
Total	201 (100)	201 (100)	402 (100)

Table 9: Distribution of sample between Clinical Officer (C.O) and Medical Officer (M. O)

DIST. OF SAMPLE POPULATION BETWEEN THE CLINICIAN AND MEDICAL OFFICER (FIG.7).



Odd's Ratio = 2.01

95% confidence interval = 1.32 - 3.04. Therefore significant.

4.2.2 Diagnosis of Controls

The commonest condition among the controls was found to be URTI accounting for 51.3% (121). This was followed by skin problems accounting for 19.5% (46) and malaria 7.6%(18). The remaining children had conditions affecting the other systems of the body. See Figure 8 below.

4.2.3 Morbidity in last 2 week period

In the period two weeks prior to being seen at the dispensary, 99.0% of the cases and 99.5% of the controls had been unwell. These illnesses were the reasons for the dispensary attendance and can be classified as shown below, (Table 10 and Figure 9) according to the systems affected:

DIAGNOSIS OF CONTROLS

FIGURE 8

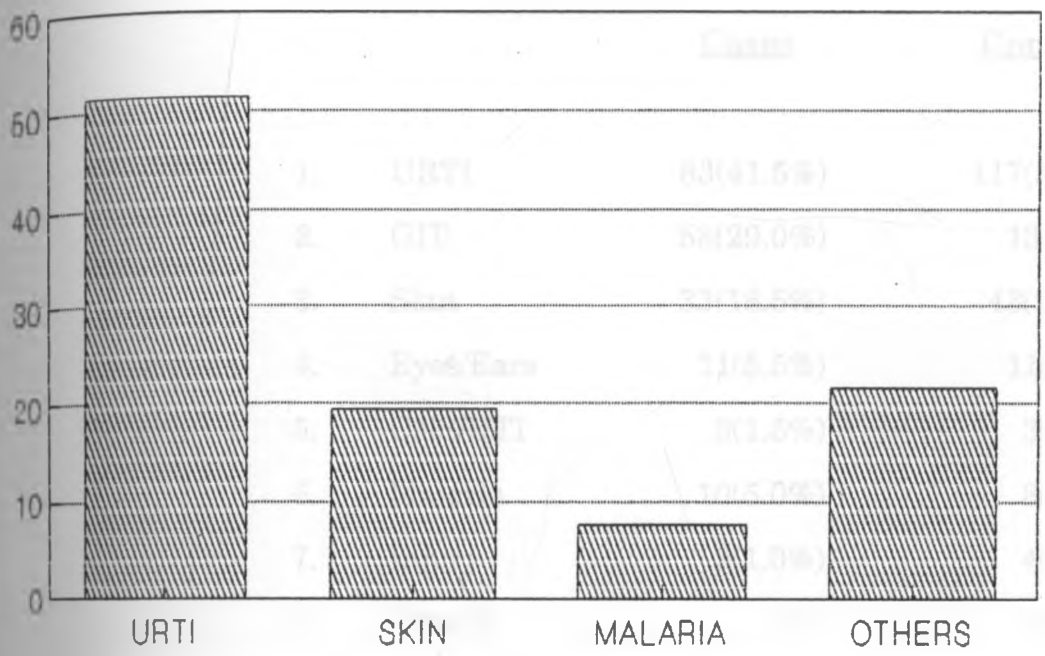


Table 10: Morbidity in sample in last two week period.

		Cases	Controls
1.	URTI	83(41.5%)	117(58.5%)
2.	GIT	58(29.0%)	13(6.5%)
3.	Skin	33(16.5%)	43(21.5%)
4.	Eyes/Ears	11(5.5%)	11(5.5%)
5.	CNS/UTI	3(1.5%)	3(1.5%)
6.	Malaria	10(5.0%)	8(4.0%)
7.	Injury	2(1.0%)	4(2.0%)
8.	Others	(0)	1(0.5%)

High frequency of GIT among cases suggests clinicians use history of GIT illness as predictor of helminthiasis.

During the same two week period, the following clinical manifestations (Table 11 and Figure 10) were found in the sample:

MORBIDITY IN THE LAST
TWO WEEK PERIOD
FIGURE 9.

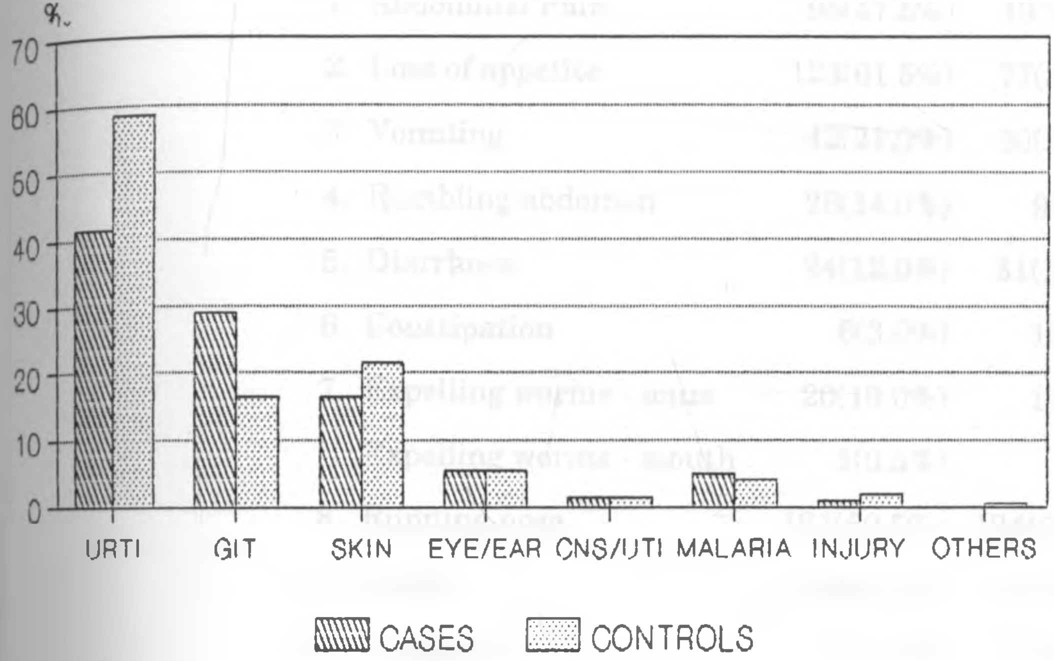


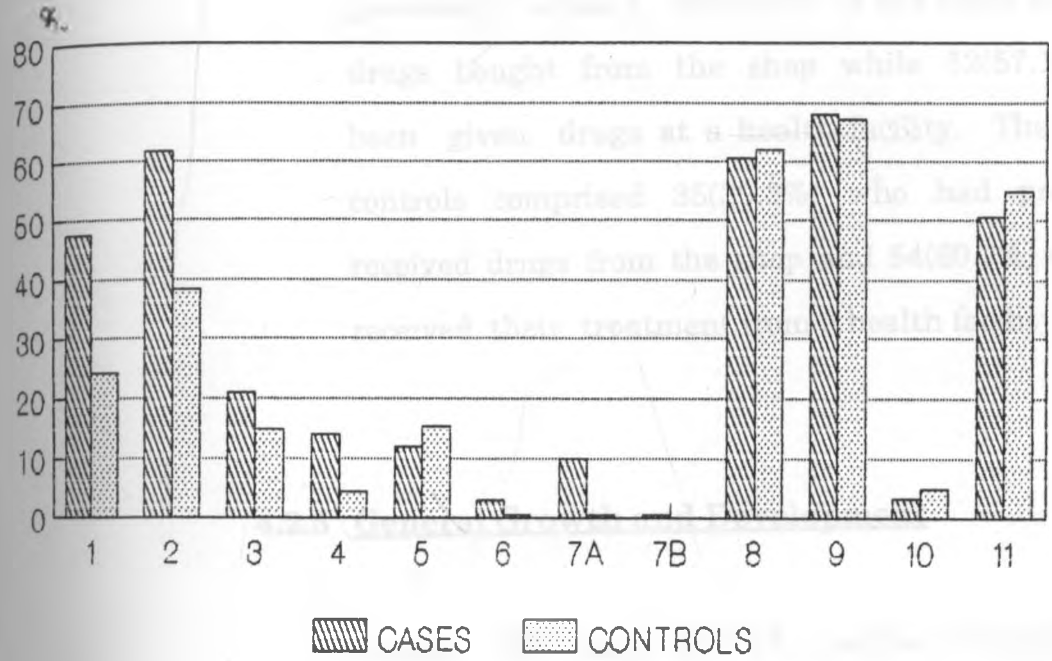
Table 11: Clinical manifestations in sample

	Cases	Controls
1. Abdominal Pain	95(47.5%)	49(24.4%)
2. Loss of appetite	123(61.5%)	77(38.3%)
3. Vomiting	42(21.0%)	30(14.9%)
4. Rumbling abdomen	28(14.0%)	9(4.5%)
5. Diarrhoea	24(12.0%)	31(15.4%)
6. Constipation	6(3.0%)	1(0.5%)
7. Expelling worms - anus	20(10.0%)	1(0.5%)
Expelling worms - mouth	1(0.5%)	0(0)
8. Running nose	121(60.5%)	124(61.7%)
9. Cough	136(68.0%)	135(67.2%)
10. Chest pain	7(3.5%)	10(5.0%)
11. Fever	10(50.5%)	110(54.7%)

These results may suggest that the clinicians used the following as predicators of helminthiasis:

1. Abdominal pain
2. Loss of appetite
3. Vomiting
4. Rumbling abdomen
5. Diarrhoea
6. Constipation
7. Passing worms

CLINICAL MANIFESTATIONS
IN SAMPLE POPULATION
FIGURE 10.



4.2.4 Previous Medical History

49.2%(94) of the cases and 48.9%(91) of the controls had previously been treated for worms. Among those previously treated, 39(42.9%) of the cases had used drugs bought from the shop while 52(57.1%) had been given drugs at a health facility. The treated controls comprised 35(39.3%) who had previously received drugs from the shop and 54(60.7%) who had received their treatment from a health facility.

4.2.5 General Growth and Development

Among the cases 15(7.5%) mothers thought their children were not growing well, while only 11 (5.5%) in the control group were reported as not growing as they should according to their companions.

4.2.6 Examination

On physical examination by the principal investigator 23.9%(48) of the cases were pale while 12.0%(24) of the controls appeared pale. This difference between the cases and controls with respect to pallor was found to be statistically significant with

Chi-square — 9.6055

P — 0.0019

4.3 Additional Information

4.3.1 Drugs

On inspection of the pharmacy, the following anthelminthic drugs were found to be present:

1. Syrup Mebendazole (Natoa)
2. Tablets Ketrax
3. Tablets Yomesan
4. Tablets Pyrantel Pamoate

All the children seen and diagnosed as having worms were given Mebendazole syrup. Generally those children under 3 years of age were given 5 mls twice a day for 3 days. 10 mls twice a day for 3 days was given to the older children.

4.3.2 Patient Returns

The average number of patients seen at the Health Centre during the day was 200 during the period May to July. Patients seen during the night were not taken into consideration. On average 100 patients were found to be children under 10 years of age. Of these 10-20% had mebendazole Natoa prescribed on their card, according to the records in the pharmacy. Not all these were part of the study as some were not interested while others were excluded e.g for being too ill with dehydration.

4.4. Helminth Results

47/163 (28.8%) of the cases and 16/162 (9.9%) of the controls showed helminths on stool examination. Stool examination revealed the following helminth eggs/ larvae as present:

Table 12: Helminth eggs/larvae seen at microscopy and their frequency

Helminths	**Number**	**Percentage**
Ascaris	32	35.96
Trichuris	25	28.09
Hookworm	24	26.97
Hymenolepis nana	5	5.62
Strongyloides	1	1.12
Taenia	1	1.12
Schistosoma mansoni	1	1.12
TOTAL	89	

The total number adds up to more than 63% because some of the children had varying combinations of worms. See Table 13 below:

Table 13: Frequency of combinations of worms

Number of helminth species	No. of children	Percentage
1	44	69.84
2	13	20.64
3	6	9.52
Total	63	100.00

The combinations of two different types of helminth were as follows:

1. Ascaris and Hookworm	-	5
2. Ascaris and Trichuris	-	4
3. Hookworm and Trichuris	-	2
4. Trichuris and H. nana	-	1
5. Ascaris and Strongyloides	-	1
		13

Table 14: Types of combination when 2 helminths are present.

Children with 3 types of helminths were found to have the following combinations:

1. Ascaris/Hookworm/Trichuris - 4
2. Hookworm/Trichuris/S. mansoni - 1
3. Hookworm/Trichuris/H.nana - 1

   6

Helminth Intensity

It is estimated that about 0.5 g of stool was examined. The egg counts were thus multiplied by 2 to get the count per gram of stool for the principal helminths species.

Ascaris

Range	Frequency
1 - 10	4
11 - 100	14
101 +	13

Hookworm

Range	Frequency
1 - 10	10
11 - 20	4
21+	11

Trichuris

Range	Frequency
1 - 10	11
11 - 20	4
21+	7

4.5 Analysis

4.5.1 Validity of Clinical Diagnosis

The validity of clinical diagnosis of intestinal helminths in this study is assessed in terms of how well it picks those with infection and how well it leaves out those without the infection.

A total of 402 children were included in this study; 201 cases and 201 controls. Out of these, 163 cases and 162 controls brought back their stool specimens for laboratory examination. The analysis carried out was therefore based only on those who had brought stool specimens and thus laboratory results were available, only for these.

There were 47 cases (28.83%) who were true positives and 116 (71.17%) were false positives.

In the control group, the false negatives were 16 (9.88%) and the true negatives 146 (90.12%). See Table 15 below:

Table 15: Clinical diagnosis versus laboratory diagnosis

	Case	Control	Total
Laboratory +	47 (28.83%)	16 (9.88%)	63 (19.38%)
Diagnosis -	116 (71.17%)	146 (90.12%)	262 (80.63%)
Total	163 (100%)	162 (100%)	325 (100%)

$X^2 = 17.49 \quad p = 2.9 \times 10^{-5}$

Odd's Ratio = 3.69

95% confidence limits 1.99 - 6.86. Therefore this is significant.

On being diagnosed clinically as having intestinal helminths, that is a case, the chances are high that they actually have eggs/larvae on stool examination.

The probability of making a correct diagnosis

$$= \frac{(47+146)x100}{325}$$

$$= 59.38\%$$

$$\text{Sensitivity} = \frac{47x100}{163}$$

$$= 28.83\%$$

$$\text{Specificity} = \frac{146 \times 100}{162}$$

$$= 90.12\%$$

Positive predictive value

$$= \frac{47x100}{63}$$

$$= 74.46\%$$

Negative predictive value

$$= \frac{146}{262}$$

$$= 55.73\%$$

The total number of false positives (116) is more than 2 times the number of true positives (47). Such results suggest that the reliability of clinical diagnosis alone is quite unacceptable.

Both sensitivity and specificity must be considered together when dealing with a diagnostive procedure. As already mentioned, an ideal test should have a sensitivity and specificity of 100%. Because it is not practically possible to get such an ideal test, that which is selected must be as close as possible. In this study, the specificity of 90.12 is quite acceptable. But on the other hand, the sensitivity is very low (28.83%). Thus, clinical diagnosis of intestinal helminths is an unsuitable diagnostic procedure.

4.5.2 To determine whether there was a difference in the clinical diagnosis rate by the clinical officer and the medical officer, the following analysis was done.

Table 16: Clinical diagnosis versus laboratory diagnosis for Clinical Officer

Clinical Diagnosis			
	Case	Control	Total
Laboratory +	34	9	43
Diagnosis -	80	76	156
Total	114	85	199

$X^2 = 9.53$ $p = 0.0002$

Odd's Ratio 3.73 (95% confidence limits = 1.68 - 8.28)
This is significant. Being diagnosed as a case by the CO is strong predicator of the presence of intestinal helminths.

Probability of making correct diagnosis

$$= \frac{34+76x100}{199}$$

$$= 55.28\%$$

$$\text{Sensitivity} = \frac{34x100}{114}$$

$$= 29.82\%$$

$$\text{Specificity} = \frac{76100}{85}$$

$$= 89.41\%$$

Positive Predictive Value

$$= \frac{34x100}{43}$$

$$= 79.07\%$$

Negative predictive value

$$= \frac{76x100}{156}$$

$$= 48.72\%$$

Table 17: Clinical diagnosis versus laboratory diagnosis for Medical Officer

Clinical Diagnosis

	Case	Control	Total
+	13	7	20
-	6	70	106
Total	49	77	126

$X^2 = 5.57$ $p = 0.018$

Odd's Ratio = 3.61

(95% confidence limits = 1.32 - 9.84).

Therefore is significant

Probability of making a correct diagnosis

$$= \frac{13+100}{126}$$

$$= 65.87\%$$

$$\text{Sensitivity} = \frac{13\text{x}100}{49} = 26.53$$

90.91%

$$\text{Specificity} = \frac{70 \text{ x } 100}{77} = 90.91\%$$

Positive predictive value

$$= \frac{13\text{x}100}{20}$$

$$= 65.0\%$$

Negative Predictive value = 66.04%

4.5.3 Risk Factors

Thirteen socio-demographic risk factors were considered in this study. Only four were found to have a significant association with the presence of intestinal helminths.

The factors listed below showed no association with the presence of helminths:

1. Sex of child
2. Province of residence
3. Estate
4. Crowding index (p = 0.09, see Table 22)
5. Latrine sharing versus not sharing
6. Mother's marital status
7. Mother's age
8. Mother's employment status

There was a significant association between the following risk factors and the presence of eggs/larvae on laboratory examination.

Table 18: Father's education status versus presence of worms

		Laboratory	Diagnosis	-
		+	-	Total
Father's	1.	6 (66.67%)	3 (33.33%)	9(100)
Education	2.	14(30.43%)	32 (69.57%)	46(100%)
Level	3.	22(12.64%)	152(87.36%)	174(100%)
		42 (18.34%)	187 (81.66%)	229(100%)

$X^2 = 20.37$ $p < 0.0001$

There was a significant difference in the education status of fathers' in the two groups that is, those with helminths and those without. Those without helminths generally had fathers with a higher education level than the other group.

2. **Mother's Education Status**

This was an important risk factor. Children with stools that showed no eggs had mothers with a relatively higher education level.

Table 19: Mother's Education Status verses presence of helminths

	Laboratory Diagnosis		
	-	+	Total
Education Level 1	7(43.75)	9(56.25)	16(100)
2	25(22.32)	87(77.68)	112(100)
3	22(14.28)	132(85.72)	154(100)
Total	54(19.15)	228(80.85)	282(100)

1. Nil 2. Primary 3. Secondary and above

$X^2 = 9.34$ $p = 0.0094$

Among the negatives, most of the mothers had a secondary education while most mothers in the other group had only primary education.

3. <u>Child's Age (months)</u>

Table 20: Child's age (months) verses presence of intestinal helminths

	Positive	Negative
No. of cases	63	262
Minimum	18	5
Maximum	128	162
Mean	67.81	56.35
Std. Deviation	28.57	32.40

$t = 2.58 \quad p = .027$

Those who were found to be having intestinal helminths tended to be older than those who did not have, and this was statistically significant.

4. **Father's Age (years)**

Table 21: Father's Age (years) verses presence of intestinal helminths.

	+	-
No. of cases	43	162
Minimum	25	24
Maimum	70	62
Mean	38.4	35.4
Std. Deviation	10.00	6.92

t = 2.22 p = 0.027

The age of the father reveals a significant association with the presence of intestinal helminths. Those with helminths have fathers who are older compared with those without.

Crowding Index

This is the number of adults and children in the household divided by the number of lining rooms available. The mean crowding index was higher among the positives than among those who were negative. Statistically, this difference was not significant at the p = .05 level.

Table 22: Number of rooms per household.

	Positive	Negative
No. of cases	63	262
Minimum	1	1
Maimum	12	10
Mean	4.114	3.662
Std. Deviation	2.211	1.832

$t = 1.69 \quad p = 0.09$

4.5.4 Signs and Symptoms

During this study some of the signs and symptoms commonly related to intestinal helminths were documented. The majority were found to have no association. Only three of these, that is, abdominal pain, rumbling in abdomen and pallor were found to have any significant association with intestinal helminths.

Abdominal Pain

50% of all the children with worms had complained of having abdominal pain while only 33.21% of those without worms had this complaint.

Table 23: Presence of helminths verses abdominal pain

	Laboratory Diagnosis		
	+	-	Total
+	31(50)	87(33.21)7	118(36.42)
Abdomen Pain			
-	31(50)	175(66.79)	7206(63.58)
Total	62(100)	262(100)	324(100)

Odd's Ratio = 2.01

95% Confidence interval = 1.14 - 3.52

Therefore having abdominal pain is a significant symptom in relation to intestinal helminths.

Yates corrected $X^2 = 5.403$

$p = 0.02$

Sensitivity $= \frac{31x100}{62} = 50\%$ +PV $= \frac{31 x100}{118} = 26.27\%$

Specificity = $\frac{175 \times 100}{262}$ = 66.79% -PV = $\frac{175 \times 100}{206}$ = 84.95%

The above sensitivity of 50% means that half of all those infected with worms were left out. Even in those without helminths only 66.79% were so identified by the absent symptom of abdominal pain.

Rumbling in Abdomen

Table 24: Rumbling in abdomen versus presence of intestinal helminths

	Laboratory Diagnosis		
	+	-	Total
Rumbling +	11(34.38)	21(65.62)	32(100)
in Abdomen -	51(17.47)	241(82.53)	292(100)
Total	62(19.14)	262(80.86)	324(100)

$X^2 = 4.29$ $p = 0.038$

Odd's ratio = 2.47 , 95% confidence limits : 1.12 - 5.45

Rumbling in the stomach was thus found to be a significant symptom in relation to the presence of intestinal helminths.

Sensitivity = $\frac{11 \times 100}{62}$ = 17.74%   +PV = $\frac{11 \times 100}{32}$ = 34.375%

Specificity = $\frac{241 \times 100}{262}$ = 91.98%   -PV = $\frac{241 \times 100}{292}$ = 82.53%

Although there is a significant association between rumbling in the abdomen and presence of intestinal helminths, the sensitivity of 17.74% is extremely low for this symptom to be of any clinical importance.

Pallor

All the children were examined for pallor by the principal investigator. The results are shown below in relation to the presence or absence of intestinal helminths.

Table 25: Presence of pallor versus presence of worms

		Laboratory Diagnosis		
		+	-	Total
Pallor	+	25 (39.68)	36 (13.79)	61 (18.83)
	-	38 (60.32)	225 (86.21)	263 (81.17)
Total		63 (100)	261 (100)	324 (100)

Odds: Ratio = 4.11

95% Confidence Limits = 2.22 - 7.61

$X^2 = 20.596$

$P<0.0001$

There is a significant association between pallor and presence of helminths.

Sensitivity = $\frac{25}{63}$x100=39.68%   +PV = $\frac{25}{61}$ x100=40.98

Specificity = $\frac{225}{261}$x100=85.88%   -PV = $\frac{225}{263}$x100=85.55

This is a significant association between the presence of helminths and pallor. But pallor on its own cannot reliably be used for diagnosis of intestinal helminths since the sensitivity is relatively low (39.68%). A specificity of 85.88% is still low?

The following signs and symptoms showed no significant association with the presence of intestinal helminths.

1. Loss of appetite
2. Diarrhoea
3. Constipation
4. Expelling worms either through the mouth or anus
5. Running nose
6. Cough
7. Chest pain
8. Fever

Table 26 <u>Previous Treatment</u> Versus Presence of intestinal helminths

	Laboratory Diagnosis		
	+	-	Total
Previously Treated +	26 (41.27)	124 (47.33)	150 (46.15)
-	37 (58.73)	138 (52.67)	175 (53.85)
Total	63 (100)	262 (100)	325 (100)

Odds Ratio = 0.78

95% Confidence Limits = 0.45 - 1.37

In total 46.15% of the sample population had been previously treated for worms and knew it. 41.27% among the cases and 47.33% among the controls belonged to this category. There was no significant difference in the results as to whether they were treated before or not.

Source of Anthelminthic

Table 27: Source of Anthelminthic versus presence of intestinal helminths.

	Laboratory Diagnosis		
	+	-	Total
Health Facility	8 (36.77)	51 (41.13)	59 (39.33)
Shop	18 (69.23)	73 (58.87)	91 (60.67)
Total	26 (100)	124 (100)	150 (100)

Odds Ratio = 0.64

95% Confidence Limits = 0.26 - 1.57

30.77% of those with helminths had been treated with drugs from a health facility while 69.23% had bought them from a shop/kiosk/chemist. As for those who were negative 41.13% had used anthelminthics from a health facility while 58.87% had bought the drugs.

The overall majority of those treated before had treated themselves (60.67%).

4.5.5 Nutritional Status

The anthropometric measurements were reported in relation to the international reference values (by age) as defined by the US National Centre for Health Statistis (NCHS) and recommended by WHO(28)

Code

1. < - 2 SD
2. - 2 SD to -1 SD
3. - 1 SD to median
4. median to 1 SD
5. > + 1 SD

(SD = Standard Deviation)

The cut-off point of those who are underweight is being taken as less than - 2 SD.

1. **Weight for Age**

Table 28: Weight for Age Versus Presence of Intestinal helminths.

Laboratory Diagnosis			
	+	-	Total
1	8 (44.44)	10 (55.56)	18 (100)
2	19 (24.05)	60 (75.95)	79 (100)
3	17(15.32)	94 (84.68)	111(100)
4	18(21.69)	65 (78.31)	83 (100)
5	1 (3.13)	31 (96.88)	32 (100)
Total	63(19.50)	260(80.50)	323(100)

$X^2_4 = 15.132$

$p = 0.0044$

Collapsing to a 2 by 2 table:

Laboratory Diagnosis

	+	-	Total
(< -1 sd)	27 (27.84)	70 (72.16)	97(100%)
(> -1 sd)	36 (15.93)	190 (84.07)	226 (100)
Total	63 (19.50)	260 (84.50)	323 (100)

Odd's Ratio = 2.04

95% Conference Interval = 1.15 - 3.59

Sensitivity = 27/63

= 42.8%

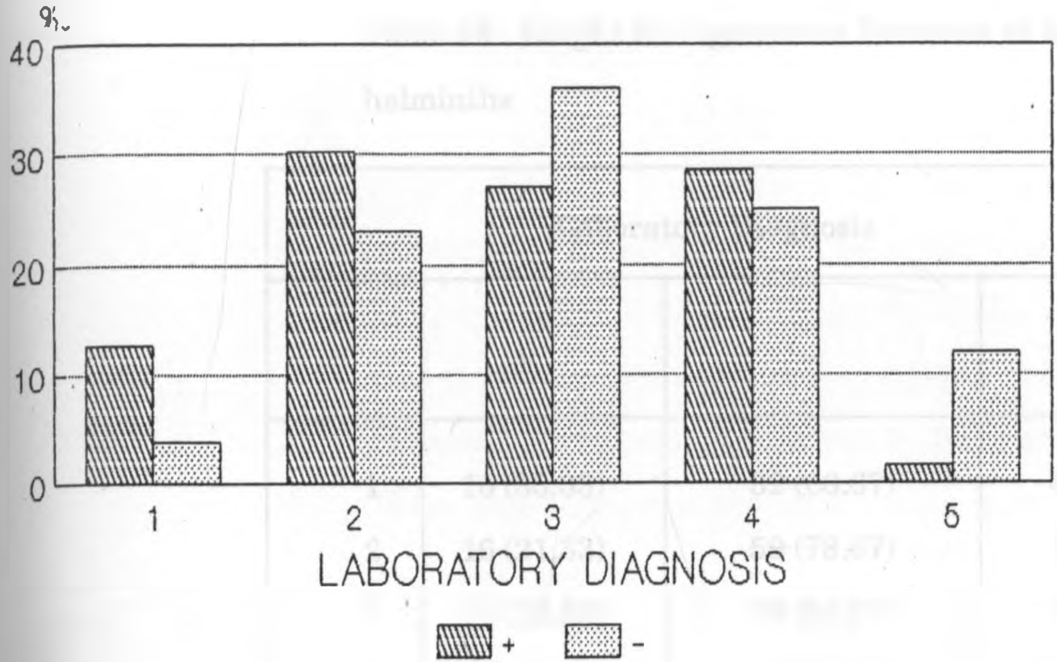
Specificity = 190/260

= 73%

Among those children that were malnourished 44.4% were infected unlike in the well nourished group the infected from 3.13% in the very well nourished to 24.05% in the borderline group.

Overall, there is a significant difference between the weights of infected children and those who had no infection. Those who were positive for intestinal helminths are lighter for age.

WEIGHT FOR AGE VERSUS
PRESENCE OF WORMS
FIGURE 11



2. Height for age

Table 29 : Height for Age versus Presence of Intestinal helminths

Laboratory Diagnosis			
	+	-	Total
1	16 (33.33)	32 (66.67)	48 (100)
2	16 (21.33)	59 (78.67)	75 (100)
3	12 (13.33)	78 (86.67)	90 (100)
4	9 (13.43)	58 (86.57)	67 (100)
5	7 (25.93)	20 (74.07)	27 (100)
Total	60(19.54)	247(80.46)	307(100)

$X^2_4 = 10.456$, $p = 0.033$

Collapsing to a 2 by 2 table:

Laboratory Diagnosis

x	+	-	Total
(< -1 sd)	32 (26.02)	91 (73.98)	123 (100)
(> -1 sd)	28 (15.22)	156 (84.78)	184 (100)
	60 (19.54)	247 (80.46)	307 (100)

Odd's ratio = 1.96

95% confidence interval : 1.11 - 3.46

Sensitivity = 32/60

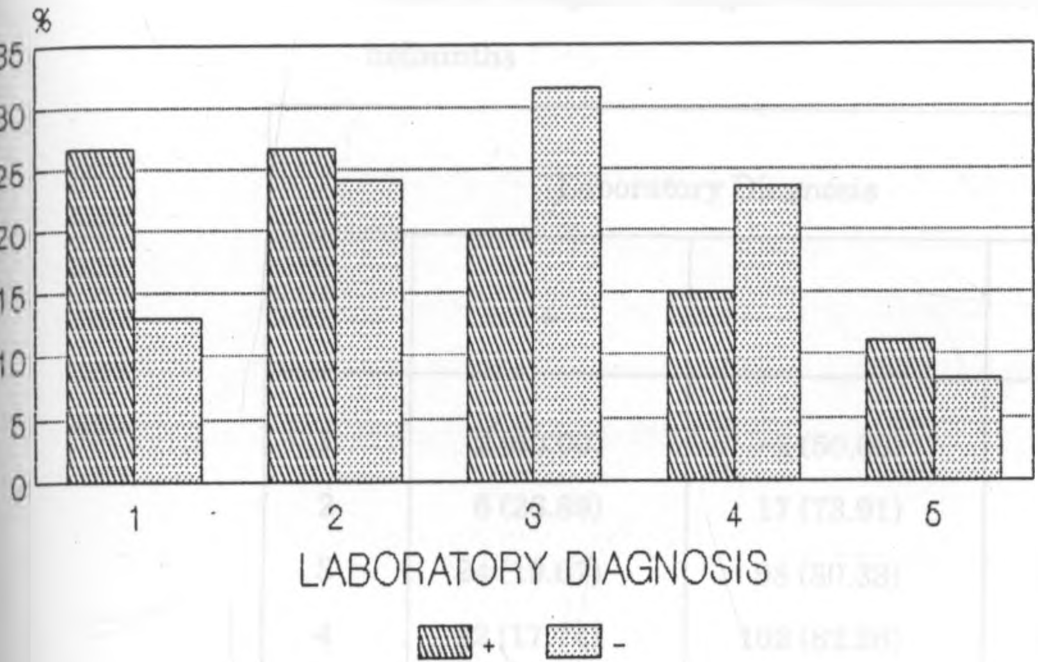
= 53%

Specificity = 156/247

= 63.1%

The majority of children in the infected group belong to category 1 and 2. Category 3 has the majority of children in the uninfected group. There is a significant difference between the two groups in relation to the height for age. Those with helminths are shorter than those without, see Figure 12.

HEIGHT FOR AGE VERSUS
PRESENCE OF WORMS
FIGURE 12



3. Weight for Height

Table 30 : Weight for Height versus Presence of intestinal helminths

	Laboratory Diagnosis		
	+	-	Total
1	2 (50.00)	2 (50.00)	4 (100)
2	6 (26.89)	17 (73.91)	23 (100)
3	24 (19.67)	98 (80.33)	122 (100)
4	22 (17.74)	102 (82.26)	124 (100)
5	6 (17.65)	28 (82.35)	34 (100)
Total	60(19.54)	247(80.46)	307(100)

$X^2_4 = 3.32$ or $23 = 2.08$ (Not significant)

Collapsing to a 2 by 2 table:

Laboratory Diagnosis

		+	-	Total
1 + 2	(< -1 sd)	8 (29.63)	19 (70.37)	27 (100)
3 + 4 + 5	(> -1 sd)	52 (18.57)	228 (81.43)	280 (100)
	Total	60 (19.54)	247 (80.46)	307 (100)

Odd's ratio = 1.85

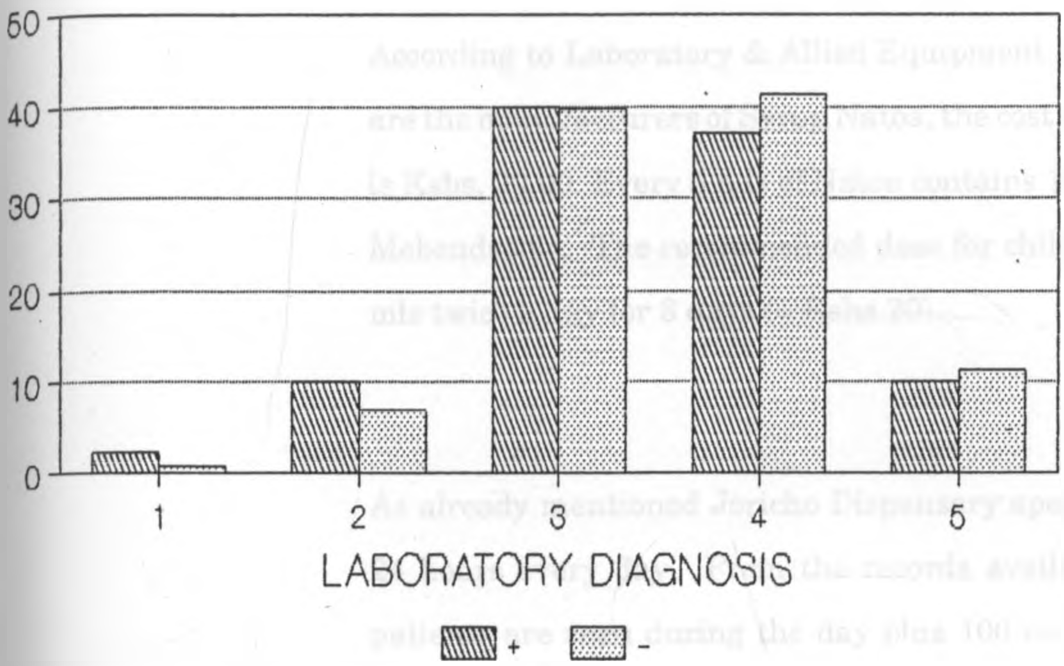
95% confidence interval : 0.76 - 4.45 (not Significant)

Sensitivity = 8/60 = 13.3%

Specificity = 228/247 = 92.3%

Looking at the weight for height, both groups have the majority of children falling in category 3 and 4. They are therefore within the normal range. There is therefore no significant difference in the weight for height between those with helminths and those without.

WEIGHT FOR HEIGHT VERSUS
PRESENCE OF WORMS
FIGURE 13



4.6 Economic Evaluation

According to Laboratory & Allied Equipment Ltd. who are the manufacturers of Syrup Natoa, the cost of 30 mls is Kshs. 20.00. Every 5 mls of Natoa contains 100 mg of Mebendazole. The recommended dose for children is 5 mls twice a day for 3 days (= Kshs.20).

As already mentioned Jericho Dispensary operates for 24 hours every day. From the records available 200 patients are seen during the day plus 100 on average during the night.

In ths analysis only the day patients will be considered. Almost half of these patients were children under 10 years of age. On each day 10-15% of the children seen, that is 20-30 were given Natoa. From the study, it was found (Table 15) that 71.17% of the 'cases' were false positives. They were given treatment that they did not require. Every day, 20 to 30 children were given Syrup Natoa but about 71.17% of these are likely to be negative on stool examination.

Amount spent every day on false positives is

$20 \text{ x } 30 \ \frac{71.17}{100}$ = Kshs. 427.04 (if 20 children treated)

$30 \text{ x } 30 \ \frac{71.17}{100}$ = Kshs. 640.53 (if 30 children treated)

Therefore the estimated cost of drugs given every month (30 days) to uninfected children is between Kshs. 12,811.20 and Kshs. 19,215.90.

Assume the technician is paid Kshs. 2,000.00 per month. If stool microscopy for children aged 10 years and less accounts for 20% of workload then stool examinations cost per month is:
20% Kshs. 2,000.00 = Kshs. 400.00

100 children under 10 are seen each day and we assume 20% of these will require stool examination. This makes it 20 patients per day. Number of patients for stool examination in one month = 20 30 = 600 Hence cost of examining one specimen = $\frac{400}{600}$

= Ksh. 0.67 + cost of consumable materials.

While undertaking the examination of 400 specimens in this study, the cost of the chemicals as well as accessory laboratory equipment was approximately Kshs. 1,000.00. When this is taken into consideration, the cost per examination becomes $0.67 + \frac{1000}{600}$ = Ksh. 2.3.

If no laboratory diagnosis is used the cost of treating 20 children per day is 20 x 20 = Ksh.400. If a laboratory test is used and 30% are positive and treatment is limited to them then drug costs = 3 x 400 = Ksh.120, to this the costs of 20 stool tests (=20 x 2.3 = Ksh.46) must be added making a total of Ksh.166 The daily saving is thus 400 - 166 = Ksh.234 and the monthly saving Ksh.7,020.

In either case none of the low risk 'clinically negative' children have been treated or tested. Results presented (Table 15) have suggested that about 10% at 80 children are missed, this is equivalent to 8 per day or 240 per month. With the drug costs saved by the laboratory tests more stools could be tested so that the number missed would be less.

Thus it is still for much cheaper using a laboratory than giving drugs to all suspected cases as is the situation now.

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DISCUSSION

Ideally, those patients found positive on clinical examination should have the infection when laboratory tests are carried out. Likewise, those with negative findings should be free from the infection. Unfortunately, this is rarely the case especially with intestinal helminths. First of all diagnosis of a disease is based on various risk factors. Secondly, the appropriate signs and symptoms should be sought. There is no one risk factor, sign or symptom which is sufficient to make a definitive diagnosis of intestinal helminths.

Helminthiasis has been shown to be related to economic and social development (3). In this content, more that 10 risk factors were looked at in this study. Of these, only four showed any significant association with the presence of worms. These were the fathers education level and the mother's education level. This serves to reinforce the potential importance of education for both parents in the control of helminthic infection.

More infection was found among the children with parents who had a lower education. This supports the third hypothesis of this study. Formal education therefore needs to be encouraged. The effect of education is likely to act mainly through better income, housing, food etc rather than changed health attitudes and behaviour themselves.

The fathers age was found to be an important factor. This may be indirectly related to the education level. Many more of the older people have had minimal or no education while most of the young parents have had a slightly higher education level.

Children are known to be more at risk of getting worm infection than adults (4). The child's age revealed a significant association with the presence of worms. This is most likely related to the behaviour of the child.

As he grows up, the behaviour changes make him more or less at risk of getting infected with worms. It is especially true when they become mobile and start exploring their environment.

From previous studies, it has been found that many individuals infected with worms are asymptomatic and some have vague generalized complaints (3). The results from this study revealed that abdominal pain and rumbling in the abdomen were the only two symptoms found to have a statistical association with the presence of worms. These are non-specific complaints and may occur in many other medical conditions.

Pallor was found to be a useful sign related to the presence of worms. But even then, it cannot be used on its own with a sensitivity of only 39% and specificity of 86%. The other signs and symptoms showed no association with helminthic infection.

Taking all these factors into consideration, it becomes very clear that making a diagnosis of intestinal helminthiasis based on a clinical criteria alone is not easy.

Anthropometry has been found to be a useful tool for the assessment of nutritional status of children. We know that any illness including helminthic infections will impair a child's growth (3,8,9). In most developing countries like Kenya, growth deficits are caused by two presentable factors, inadequate food intake and infection. We must also bear in mind that genetic factors also affect growth and development of an individual.

Wasting and stunting refer to different biological processes of malnutrition. Their indicators are weight for height (wasting), and height for age (stunting). Wasting indicates a deficit in tissue and fat compared with the amount expected in a child of the same height.

This may result from failure to gain weight or from actual weight loss. It may be precipitated by an infection or some other household crisis especially in a situation where the family food supply is limited resulting in an inadequate intake by the child. One of the main characteristics of wasting is that it can develop very rapidly and under favourable conditions, can be restored rapidly.

Stunting on other hand signifies a slowing in skeletal growth. This growth rate may be reduced from birth but a significant degree of stunting representing the accumulated consequences of retarded growth may not be evident for some years. Stunting is frequently found to be associated with poor overall economic conditions. It occurs especially when a child experiences chronic or repeated infections together with inadequate nutrient intake.

It has been shown in this study using the two parameters weight for age and height for age, that there is a significant difference between the infected and uninfected.

Those with helminth infection are both shorter and lighter for their age. Protein energy malnutrition (PEM) is thus more common among the infected children who are stunted but not wasted as there was no reduction in the weight for height parameter. These findings support the second hypothesis.

Intestinal helminths are known to be recurrent and persistent infections. This results in growth faltering and eventually malnutrition. This form of malnutrition continuing for a long time leads to stunting but not necessarily to wasting. The hypothesis on PEM being higher in children with intestinal helminths than those without has been supported.

The mechanism of action of the various worms leading to malnutrition is varied, some cause malabsorption of nutrients, competing for nutrients with the host and causing damage to the tissues. However, recent studies have emphasized the role of reduced appetite leading to reduced food intake.

Although growth monitoring for children should continue to the age of 5 years in the MCH clinics, this does not in reality often occur. Most of the mothers stop bringing their children after one year of age when immunization is completed. This implies that children who are under weight can only be picked before one (1) year of age, and helminthic infections do not normally cause morbidity below 1 year.

Because of the close association between PEM and helminthic infection, children coming to a dispensary can be routinely weighed as a screening procedure. If found to have PEM, these can be sent for stool examination.

It is clear from the result obtained on the validity of clinical diagnosis that there is over-diagnosis of intestinal helminths in the dispensary studied. There is no reason to believe this dispensary to be different from many others around the country.

Clinical diagnosis versus laboratory diagnosis of intestinal helminths thus show a great discrepancy as stated in the first hypothesis. This situation gives rise to various factors that need to be considered:-

1. There are many children (the false positives) who are being given drugs that will not benefit them. This may in turn give the parent/guardian false confidence that a child has received effective medication when in actual fact he has not. Because these children have complaints, it is possible that they may be having another condition (possibly more serious) that is being missed. Could the drugs that the children are getting be producing unnecessary side effects or even be aggrevating the condition of the patient?

2. Overdiagnosis of helminthic infection results in over use of the available drugs. More money is therefore spent on buying the anthelminthics than is necessary. The use of laboratory facilities can cut down on this expenditure quite significantly.

This also supports the fourth hypothesis that the current use of anthelminthic drugs is inefficient and not cost effective. Similar findings have been reported in studies on Malaria (20) and **Ascaris** (14).

The sensitivity of clinical diagnosis of intestinal worms in this study was found to be low (28.8%). This indicates that a large proportion of those who are infected are being diagnosed as some other condition. They thus get other drugs and not anthelminthics. These untreated children constitute a potential source of infection for the uninfected as well as for those who had already been adequately treated.

The effectiveness of such a diagnosis procedure being used alone in the control and management of intestinal helminths appears quite inadequate and unacceptable.

The question that should be raised is whether this method will reduce the incidence and thus the prevalence of intestinal worms. It is unlikely to have much impact and it will not be cost effective; hence the answer is negative.

Despite all the available evidence, clinical diagnosis and treatment continues to be the most widely used control method in the majority of the health facilities in Kenya at the moment.

In Health Services as in any other field of public expenditure, choices must be made between alternative policies. The necessity for choice arises from the fact that there exists a large number of clinical activities which could contribute to the welfare of the society. Resources however are limited and add up to much less than the total required to carry out these activities. Priorities must therefore be set with adequate information.

The public decision maker would like to choose projects or activities that would have the greatest accesses of advantages over disadvantages to the whole community. Presently, the control of intestinal helminthis is based on treatment given at the health facilities like Jericho Dispensary. This in the majority of cases is given without the support of laboratory findings. Prior to the carrying out of this study, there was no evidence to show that the effectiveness of this method had been evaluated at any time.

RECOMMENDATIONS

The findings from the study have revealed a major shortfall in the management and control of intestinal helminths in our situation. There is a need to improve on the delivery of health services especially as it relates to helminthic infection in order to reduce the prevalence rates.

Specially trained miscroscopists should be used to do some basic parasitological work. This would be of real benefit not only to the patient and the community as a whole, but would also give the clinician more confidence as he prescribes his treatment.

After the age of one year, most children are brought to the health institutions only when sick. It is therefore recommended that the services offered at each health facility be integrated so that children up to the age of 5 or even 10 years can be routinely weighed and their height taken.

It is very difficult for a mother to go to one place for a child who is sick to receive treatment, and then to a different queue for weighing. Because PEM has been found to be a risk factor, such children should be investigated and have stools examined. In areas known to have high prevalence rates of intestinal helminths, such children can even be routinely treated for worms.

Because children are at a higher risk of getting intestinal worms than adults, more control measures should be directed towards them. Within the Nursery and Primary schools, there is a captive population. Some of those schools should be used as diagnostic and treatment centres. Only those found to be positive after stool microscopy should be given the appropriate treatment. In localities where prevalence is very high mass treatment without a stool test may be cost effective.

Lack of education for parents was found to be a major risk factor. But giving more education alone would not necessarily have an effect on helminthic infection.

There is a need for the general improvement of the present social economic situation.

The various sectors of the government like Education, Health, Agriculture, Housing etc must all work together as they offer their services to the same people. This is especially necessary in communities or groups of people known to be at high risk of getting the infection.

The majority of the poor people live in areas where intestinal helminths are a problem. Much more co-ordinated work needs to be done and applied to such challenges on a wider scale. Such studies could he done with larger sample populations, where prevalence levels are higher or lower, and for longer periods of time.

Chapter 6

APPENDICES

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Appendix1 : DATA CAPTURE INSTRUMENT

No: ....

Date:...

CLINICAL DATA FORM

(Tick as appropriate)

1. Name of child

   ....

2. Sex 1. Male ( ) 2. Female ( )

3. Age (months)

4. Date of birth

5. Is the child a 1. Case ( ) 2. Control ( )?

6. If a control, what is the diagnosis?

   ....

7. Has the child always lived in Nairobi?

1. Yes ( ) 2. No ( )

8. If no, where else has the child lived

....

9. Where in Nairobi do you live?

Estate: ....

House No: ....

10. How many rooms are there in the house you live in?

11. How many adults live in the house?

12. How many children live in the house?

13. What is you source of water?

1. Tap in house ( )
2. Standpipe ( )
3. Other specify ( ) ....

14. Is your latrine shared by other households?

1. Yes ( ) 2. No. ( )

Parents Data

15. Are you 1. Single ( ) 2. Married ( )
    3. Divorced or separated ( )

16. Father's name ....

17. Father's age (years) ....

18. Fathers education status
    1. Nil ( )
    2. Primary ( )
    3. Secondary ( )
    4. Professional ( )
    5. University ( )
    6. Other (specify) ( )

19. Is the father employed? 1. Yes ( ) 2. No. ( )

20. What type of job does he do? ....

21. Mother's name...

22. Mother's age ....

23. Mother's education status

1. Nil ( )
2. Primary ( )
3. Secondary ( )
4. Professional ( )
5. University ( )
6. Other (specify) ( )

24. Is the mother employed? 1. Yes ( ) 2. No ( )

25. What type of job does she do?

26. Are you the only wife? 1. Yes ( ) 2. No. ( )

27. If No how many other wives are there?

CHILD'S MEDICAL HISTORY

28. Has the child had any illness in the last two weeks?

    1. Yes ( ) 2. No. ( )

29. If yes what illness?..

30. Was this reason for the clinic attendance today?

    1. Yes ( ) 2. No ( )

31. If No what was the reason? ....

Last two weeks		1. Yes	2. No
1.	Abdominal pain	( )	( )
2.	Lost appetite	( )	( )
3.	Vomiting	( )	( )
4.	Rumbling stomach	( )	( )
5.	Diarrhoea	( )	( )

6.	Constipation	( )	( )
7.	Passing out worms - from anus	( )	( )
	(from mouth	( )	( )
8.	Running Nose	( )	( )
9.	Cough	( )	( )
10.	Chest pain	( )	( )
11.	Fever	( )	( )
12.	Swollen feet	( )	( )
13.	Pallor (anaemia)	( )	( )
14.	Other specify		

33. Has your child been treated for worms before?

1. Yes ( ) 2. No ( )

34. Was he/she treated with

1. Medicine bought from the shop ( )

2. Medicine bought from the health facility ( )

35. Is your child growing normally ?

1. Yes ( ) 2. No ( )

36. If the child is not growing normally, what do you think is the reason ? ....

....

PHYSICAL EXAMINATION

37. Mucosal pallor 1. Present ( ) 2. Absent ( )

38. Weight (kg)

39 Height/Length (cm)

LABORATORY DATA FORM

1. Data specimen examination in laboratory

2. Height of fluid level in container (mm)

3. Helminth Eggs/larvae seen 1. Yes 2. No

Ascaris	( )	( )
Hookworm	( )	( )
Trichuris	( )	( )
Taenia	( )	( )
Enterobius	( )	( )
Other specify	( )	( )

Appendix II : Analysis

For analyzing validity of clinical diagnosis of Intestinal Helminths, a two by two table was used as shown below:

		Clinical Diagnosis		Total
		+	-	
Laboratory	+			
Exam	-			
	Total			

For each of the clinical manifestations e.g. loss of appetite, a 2 by 2 table was also used.

Loss of appetiteTotal

+ -

Laboratory +

Exam -

Total

For each of the clinical manifestation e. g. loss of appetite a 2 by 2 table was also used.

	Loss of appetite			Total
		+	-	
Laboratory	+			
Exam	-			
	Total			

Appendi III : Definitions

Validity is here defined as the frequency with which the results of an initial clinical examination is confirmed by subsequent Laboratory diagnosis. It measures the degree of concordance between the clinical and laboratory test results.

Clinical Examination

		Case	Control	Total
Laboratory	+	a	b	a+b
Examination	-	c	d	c+d
TOTAL		a+c	b+d	a + b + c + d

Sensitivity is the accuracy of a test in identifying all the diseased subject in the study population. Ideally this should be 100%.

$$= \frac{a}{a+c} \times 100$$

Specificity is the accuracy of a test in identifying all the non disease subjects in the study population. It should also be 100% in an ideal situation.

$$= \frac{d}{b+d} \times 100$$

These two parameters cannot be used in isolation for any one test. They must be considered together and ought to be as near 100% as possible for the test to be completely valid.

False Positive

This is the number of those screened as positive and who are subsequently found to be normal on laboratory examination (b).

Positive Predictive value

$$= \frac{\text{Number of test positives}}{\text{True positives}} = \frac{a}{a+b}$$

Negative predictive value

$$= \frac{\text{Number of those rejected by test}}{\text{True negatives}} = \frac{d}{c+d}$$

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